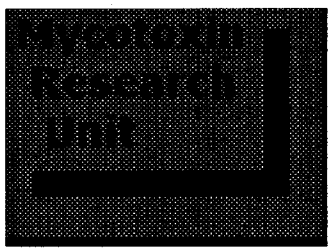


ars USDA NCAUR

Research Leader: David Kendra

Unit Secretary: Gail Bursott

Plant diseases caused by fungi, including Ear Rot of corn and Head Blight of wheat, are a major problem for US agriculture. Toxins produced by some of these fungi (mycotoxins) also cause disease in domestic animals. Losses occur from reduced grain quality, reduced animal productivity, and the costs of monitoring and diverting contaminated grain from the human food supply. The goal of the Mycotoxin Research Unit at NCAUR is to develop strategies that reduce or eliminate the presence of mycotoxins in human foods and animal feeds. Research within the unit is focused on toxins produced by fungi of the genus *Fusarium* as well as the diseases caused by these fungi. The unit has four major research projects the objectives of which include developing new technologies for the detection of mycotoxins, determining the genetic and biochemical basis of mycotoxin production, identifying genes that confer resistance to mycotoxins, determining the role of mycotoxins in plant disease, elucidating factors required by fungi to cause crop diseases, and understanding the diversity, dissemination and competitive interactions of toxigenic fungi in the field.

Research

Mycotoxin Research Personnel

Recent Publications

Links

RESEARCH

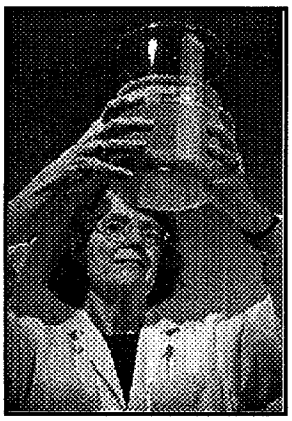
Fusarium Head Blight Research

The major objective of this research is to reduce the occurrence and severity of *Fusarium* head blight, or scab, in small grain crops such as wheat and barley and to reduce the level of the mycotoxin deoxynivalenol that accumulates in grain as a result of this disease. *Fusarium* head blight is a devastating and economically important crop disease, particularly in the upper Midwest where it caused over $1 billion in losses to wheat and barley producers during the 1990s. The primary cause of this disease is the fungus *Fusarium graminearum*, which infects wheat heads during flowering and causes a reduction in yield and quality of grain. The fungus also produces the trichothecene mycotoxin deoxynivalenol (DON) in infected grain. The presence of DON can greatly reduce the value of of grain and limit its use for food and feed. Experiments at NCAUR have demonstrated that DON enhances the ability of *F. graminearum* to cause head blight on wheat. These findings indicate that it may be possible to increase the resistance of wheat to head blight by increasing its resistance to DON. Thus, further experiments are underway to identify fungal and plant genes that confer resistance to DON. Research is also underway to decipher the genetic and biochemical pathways that lead to the formation of trichothecenes, to elucidate the genetic and biochemical factors that regulate trichothecene production and to identify other genetic, physiological and ecological factors that allow *F. graminearum* to infect wheat and cause epidemics of head blight. Annual Report

Fumonisin Research

The major objective of this research is to reduce or eliminate the levels of fumonisins in corn. Fumonisins are a group of mycotoxins that cause several fatal livestock diseases as well as cancer in laboratory studies with rats and mice. These toxins are produced by the fungus *Fusarium verticillioides*, which causes ear rot of corn. The fumonisin research at NCAUR has been instrumental in the development of analytical methods for the detection and quantification of the mycotoxins. These methods have been used to demonstrate that fumonisins accumulate primarily in symptomatic kernels of corn with ear rot. These findings indicate that the elimination of ear rot in corn should be an effective way to reduce fumonisin contamination of corn. Other research at NCAUR has been instrumental in identifying genes in *F. verticillioides* that are necessary for the biosynthesis of fumonisins. Current research objectives include I) determining whether fumonisin production by *F. verticillioides* enhances the ability of the fungus to cause ear rot of corn, ii) developing a biotechnological strategy to prevent fungal invasion of corn kernels via the seed stalk, iii) deciphering the genetic and biochemical pathways that lead to the formation of fumonisins, and iv) elucidating the genetic and biochemical factors that regulate fumonisin production. Annual Report

Biosensors in Mycotoxin Detection Research



Assessment of the extent of contamination is the essential first step in reducing exposure to mycotoxins. The objective of this project is to develop rapid, accurate, and sensitive methods for determining toxins such as trichothecenes, fumonisins, and aflatoxins in food through the development of novel detection technologies. Measurement of mycotoxins is necessary in a variety of situations ranging from in the field to in controlled laboratory settings. Accordingly, the technologies being developed range from those which can be conducted rapidly with minimal technical expertise, such as immunoassays and biosensors, to those which can be conducted by technical personnel. Rapid detection (or screening) technologies which have been developed at NCAUR include immunologically based methods such as enzyme linked immunosorbent assays (ELISAs) and biosensors using specific monoclonal antibodies. Alternatives to the use of antibodies in rapid assays are also being explored. Rigorous methods for mycotoxin detection are required to confirm the results from screening assays, and these include technologies such as capillary electrophoresis (CE), high performance liquid chromatography, gas chromatography, and hybrid technologies that combine these techniques with immunoassay. Annual Report

Aflatoxin Research

Contamination of corn with aflatoxin, a mycotoxin produced by the fungus *Aspergillus flavus*, is a recurrent problem in the southern USA, but when occasional serious outbreaks occur in the Midwest 'Corn Belt' the bulk of the U.S. corn crop is at risk. The aflatoxins can cause liver damage or cancer, suppress the immune system, and reduce the productivity of farm animals. Aflatoxins are the only mycotoxins that are formally regulated by the U.S. Food and Drug Administration. In 1988, the International Agency for Research on Cancer (IARC) placed aflatoxin B1 on their list of human carcinogens. Our research to control *A. flavus* infection of pre-harvest corn follows an integrated approach to disease management. Basic ecological information about the *A. flavus* disease cycle, fungal survival, and dissemination within crop fields has produced new biocontrol strategies and guided our discovery of novel fungal metabolites active against *Aspergillus and Fusarium.* Characterization of competitively superior non-aflatoxin producing *A. flavus* populations that may naturally suppress aflatoxin outbreaks in midwestern corn is facilitated using a DNA probe that we developed. Our research has identified seed coat tearing as a critical susceptibility factor in corn kernel infection and aflatoxin contamination of the grain. Cooperative research with corn breeders seeks to improve kernel resistance to *Aspergillus and Fusarium* kernel rotting molds by reducing hybrid susceptibility to seed coat tearing through conventional breeding. Competing fungi and other microbes are being examined as potential confounding variables in interpreting corn varietal resistance to mycotoxins. Annual report

- ***Licence availability for Natural products extracted from fungal sclerotia that exhibit varying degrees of pesticidal activities.***

Aspergillus flavus sclerotium germinating on soil surface.